

NIOSH EMERGENCY RESPONSE CARD

**BLISTER AGENT**

**MUSTARD**

UN #: 2810 (Guide 153)

CAS # 505-60-2; 39472-40-7; 68157-62-0

RTECS #: WQ0900000

H; HD; HS  
 Mustard Gas  
 Bis-(2-chloroethyl)sulfide  
 sulfur mustard  
 1,1', thiobis[2, chloroethane]

Chemical Formula: C<sub>4</sub>H<sub>8</sub>Cl<sub>2</sub>S

Molecular mass: 159.08

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ CLINICAL SIGNS/ SYMPTOMS	PREVENTION/ PERSONAL PROTECTIVE EQUIPMENT	FIRST AID/ FIRE FIGHTING
<b>FIRE</b>	N/A	N/A	Water, fog, foam, CO <sub>2</sub> , dry chemical. Avoid methods that cause splashing or spreading. Fight fire from as far a distance as possible.
<b>EXPLOSION</b>	N/A	N/A	N/A

**ROUTE OF EXPOSURE**

<b>Synopsis:</b>	<b>Severe irritant. Contact with vapor or liquid can be fatal.</b>	<b>Do not breathe fumes. Skin contact must be avoided at all times.</b>	<b>Seek medical attention Immediately.</b>  Triage procedures and medical management guidelines - see <a href="#">ATSDR medical management guidelines for Blister Agents</a> .
<b>Inhalation:</b>	<ul style="list-style-type: none"> <li>Delayed effects between 2 and 24 hours after exposure.</li> <li>Runny nose.</li> <li>Dry/barking cough.</li> <li>Hoarseness.</li> <li>"Toneless" voice.</li> <li>Hemorrhage and necrosis of lung tissue resulting in coughing up blood.</li> <li>Difficulty breathing.</li> </ul>	Hold breath until respiratory protective mask is donned.  Pressure demand, self-contained breathing apparatus (SCBA) (SCBA CBRN, if available) is recommended in response situations to any amount of agent  CBRN, Full Facepiece APR (when available) is recommended in non-routine, emergency situation environments less than IDLH but above REL or PEL levels.	Immediately remove from source of exposure.  If breathing is labored give oxygen.  If breathing has stopped give artificial respiration. Mouth-to-mouth only when no facial contamination.  Seek medical attention immediately.
<b>Skin:</b>	Rapid penetration (within 1-2 minutes) without irritation.  Reddening, swelling, and blisters (small to very large) in 4-24 hours depending on dose.	Butyl rubber, neoprene, nitrile or PVC (Polyvinyl Chloride) gloves, Responder® CSM protective clothing including PVC boots.	Immediately remove contaminated clothing and wash exposed area thoroughly with soap and water. Contaminated clothing can expose rescue workers through direct contact or through off-gassing vapor.  <i>(See Decontamination section.)</i>

	Warm, moist, thin-skinned areas are the most sensitive to this agent.		Seek medical attention Immediately.
<b>Eyes:</b>	<ul style="list-style-type: none"> <li>The eyes are the most sensitive organ and effects occur between 1-12 hours after exposure.</li> <li>Tearing (lacrimation.)</li> <li>Light sensitivity.</li> <li>Irritation of lining of eye (conjunctiva) and cornea.</li> <li>Severe necrosis.</li> <li>Blindness.</li> </ul>	Chemical goggles and face shield.	<p>Immediately flush with large amounts of tepid water for at least 15 minutes.</p> <p>Do not cover with bandages. Use dark or opaque goggles.</p> <p>Seek medical attention Immediately.</p>
<b>Ingestion:</b>	<p>Nausea and vomiting common in first few hours and limited to 24 hours.</p> <p><i>(See Inhalation for other symptoms.)</i></p>	Do not eat, drink, or smoke during work. Wash hands before eating.	Do not induce vomiting. Give milk to drink. Seek medical attention Immediately.
<b>OCCUPATIONAL EXPOSURE LIMITS (OELs):</b>	<p>OSHA PEL: N/A                  NIOSH REL: N/A                  ACGIH TLV: N/A                  TLV : 0.003 mg/m<sup>3</sup> (U.S. Military)                  General Population Limit (72 hours) 0.0001 mg/m<sup>3</sup> (U.S. Military)                  NIOSH IDLH: N/A</p> <p><i>(See Acute Exposure Guideline Levels below.)</i></p>		
<b>SAMPLING AND ANALYTICAL METHODS:</b>	<p>NIOSH: N/A</p> <p>OSHA: N/A</p>		

<b>DECONTAMINATION</b>	<ul style="list-style-type: none"> <li><b>Patients/Victims:</b> Remove clothes and place contaminated clothes and personal belongings in a sealed double bag. Decontamination of mustard-exposed victims by either vapor or liquid should be performed within the first two minutes following the exposure to prevent tissue damage. If not accomplished within the first several minutes, decontamination should still be performed to ensure any residual liquid mustard is removed from the skin or clothes or to ensure any trapped mustard vapor is removed with the clothing. Removing trapped mustard vapor will prevent vapor off-gassing or subsequent cross-contamination of other emergency responders/health care providers or the healthcare facility. Physical removal of the mustard agent, rather than detoxification or neutralization, is the most important principle in patient decontamination. Mustard is not detoxified by water alone and will remain in decontamination effluent (in dilute concentrations) if hydrolysis has not taken place.</li> </ul> <p>(1) Patients exposed to vapor should be decontaminated by removing all clothing in a clean air environment and shampooing or rinsing the hair to prevent vapor off-gassing.</p> <p>(2) Patients exposed to liquid should be decontaminated by –</p> <p>a. Washing in warm or hot water at least three times. Use liquid soap (dispose of container after use and replace), large volumes of water, and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. Scrubbing of</p>
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	<p>exposed skin with a brush is discouraged, because skin damage may occur which may enhance absorption. The third wash should be to rinse with large amounts of warm or hot water. Shampoo can be used to wash the hair. The rapid physical removal of a chemical agent is essential. If warm or hot water is not available, but cold water is, use cold water. Do not delay decontamination to obtain warm water.</p> <p>b. Rinsing the eyes, mucous membranes, or open wounds with sterile saline or water.</p> <p>(3) The healthcare provider should –</p> <p>a. Check the casualty after the three washes to verify adequate decontamination before allowing entry to the medical treatment facility. If the washes were inadequate, repeat the entire process.</p> <p>b. Be prepared to stabilize conventional injuries during the decontamination process. Careful decontamination can be a time consuming process. The health care provider may have to enter the contaminated area to treat the casualty during this process. Medical personnel should wear the proper PPE and evaluate the exposed workers.</p> <p>(see the following for more information <a href="#">ATSDR medical management guidelines</a>, <a href="#">SBCCOM Guidelines for Mass Casualty Decontamination During a Terrorist Chemical Agent Incident (January 2000)</a>, and <a href="#">SBCCOM Guidelines for Cold Weather Mass Decontamination During a Terrorist Chemical Agent Incident (January 2002)</a>.)</p> <ul style="list-style-type: none"> <li>● <b>Equipment:</b> Use 5% solution of common bleach (sodium hypochlorite) or calcium hypochlorite solution (48 ounces per 5 gallons of water) to decontaminate scissors used in clothing removal, clothes and other items.</li> <li>● <b>Environment:</b> (<i>See Spillage Disposal.</i>) Common bleach (sodium hypochlorite or NaOCl), superchlorinated bleaches (calcium hypochlorite or Ca(OCl)<sub>2</sub>) and chloramine can be used.</li> </ul>
<p><b>SPILLAGE DISPOSAL</b></p>	<p>Cover with vermiculite, diatomaceous earth, clay, or fine sand and neutralized as soon as possible using large amounts of 5% sodium hypochlorite solution. Scoop up all material and place in an approved container. After sealing, decontaminate the exterior and label. All leaking containers should be packed with sorbent (e.g. vermiculite) and placed between the interior and exterior containers. Label and dispose according to regulations. Conduct general area monitoring.</p> <p>If sodium hypochlorite solution is not available then use the following in order of preference: Calcium Hypochlorite and Super Tropical Bleach Slurry (STB). WARNING: Pure, undiluted Calcium Hypochlorite (HTH) will burn on contact with liquid blister agent.</p>
<p><b>PACKAGING &amp; LABELLING</b></p>	<p>UN # <a href="#">2810</a> (Guide 153)</p> <p>Proper Shipping Name: Toxic liquids, organic, n.o.s.</p> <p>Hazard Class: 6.1, Packing Group I, Hazard Zone B.</p> <p>Label: Poison.</p> <p>Marking: Toxic liquids, n.o.s. Bis-(2-chloroethyl) sulfide UN 2810, Inhalation Hazard</p> <p>Placard: Poison</p> <p>NFPA 704 Signal:</p> <p>Health - 4          Flammability - 1          Reactivity - 1          Special - 0</p>
<p><b>IMPORTANT DATA</b></p>	<p><b>PHYSICAL STATE; APPEARANCE:</b>          Pure liquid is colorless and odorless. Forms yellow prisms on cooling. Agent grade material is yellow to dark brown or black and the odor is variously described as similar to burning garlic, horseradish, a characteristic sweetish odor, or a weak, sweet, agreeable odor.</p>

	<p><b>PHYSICAL DANGERS:</b> Rapidly corrosive to brass at 65 °C. Will corrode steel at a rate of 0.0001 in. of steel per month at 65 °C.</p> <p><b>CHEMICAL DANGERS:</b> Stable at ambient temperatures. Decomposition temperature is 300-351 °F (149-177 °C). Reacts with water yielding hemi-mustard (a short-lived blister agent), thiodyglycol, and hydrogen chloride (HCl) with a half-life of 16 min. (<i>see Environmental</i>). On contact with acid or acid fumes, it emits highly toxic fumes of oxides of sulfur and chlorine. When heated to decomposition, oxides of sulfur and chlorine are emitted.</p> <p><b>ROUTES OF EXPOSURE:</b> The substance can be absorbed into the body by all routes. Tender skin, mucous membranes and perspiration-covered skin are more sensitive to the effects.</p> <p><b>INHALATION RISK:</b> MUSTARD, a chlorinated sulfur compound, is a blister agent (vesicant) that causes severe, delayed damage to the respiratory tract. It is an alkylating agent that damages the cells within the bone marrow that are necessary for making blood cells.</p> <p><b>EFFECTS OF SHORT-TERM EXPOSURE:</b> MUSTARD damages the tissues the eyes, skin and respiratory tract. The skin healing process is very slow. Exposure to nearly lethal doses can injure the bone marrow, lymph nodes, and spleen causing a drop in white blood cell counts and an increased risk for developing infections.  MUSTARD exposure can also cause a cholinergic toxicity: excessive saliva, tearing, urination, gastrointestinal cramping and diarrhea, vomiting, small pupils.</p> <p><b>EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:</b> The rate of detoxification is very slow in the body and repeated exposures produce cumulative effects including chronic lung impairment (cough, shortness of breath, chest pain), cancer of the mouth, throat, respiratory tract and skin, and leukemia. It may also cause birth defects. A human carcinogen.</p>
<p><b>PHYSICAL PROPERTIES</b></p>	<p>Melting Point: 57.2°F (13-14°C)</p> <p>Boiling Point: 419°F-422° F (215-217°C) (decomposes)</p> <p>Vapor Pressure (25°C): 0.11 mm Hg</p> <p>Vapor density: 5.4 (Air=1)</p> <p>Volatility: 600 mg/m<sup>3</sup> at 20°C</p> <p>Specific Gravity: 1.27 at 20°C (liquid) 1.34 at 13°C (solid) aqueous solubility (20°C): 0.8 g/L</p> <p>Miscible with the organophosphorus nerve agents.</p> <p>Soluble in fats and oils, gasoline, kerosene, acetone, carbon tetrachloride, alcohol, tetrachloroethane, ethylbenzoate, and ether.</p> <p>Estimated log K<sub>ow</sub>: 1.37 - 2.41</p> <p>log K<sub>benzene-water</sub>: 0.15</p> <p>Flashpoint: 220°F (104°C)</p> <p>Flammability: (can be ignited by large explosive charges)</p>
<p><b>ENVIRONMENTAL DATA</b></p>	<p>Bulk MUSTARD can persist for decades in soil or water. When exposed to sea water, mustard forms a thick outer "crust" over a core of mustard which allows the mustard to be brought to the surface where it can injure unsuspecting fishermen who may snare plastic lumps of mustard gas in their nets.</p> <p>MUSTARD and a number of its hydrolysis products are oxidized (air, oxygen, hypochlorite, hydrogen peroxide, nitric acid, potassium permanganate, and chromic acid) to give the less toxic sulfoxide and sulfone analogs.</p> <p>MUSTARD and its hydrolysis products do not significantly degrade in sunlight and are stable at less than 49°C.</p>

<b>ACUTE EXPOSURE GUIDELINES (AEGLs)</b>  <b>(FINAL)</b>		10 min	30 min	1hr	4 hr	8 hr
	AEGL 1 (discomfort, non-disabling) - ppm	0.06	0.02	0.01	0.003	0.001
	AEGL 2 (irreversible or other serious, long-lasting effects or impaired ability to escape) - ppm	0.09	0.03	0.02	0.005	0.002
	AEGL 3 (life-threatening effects or death) - ppm	0.59	0.41	0.32	0.08	0.04

**NOTES**

HD is distilled sulfur mustard which has been purified by washing and vacuum distillation. H is Levinstein mustard which contains about 30% sulfur impurities and has a stronger vesicant action. HT consists of 60% HD and 40% T (a related vesicant with lower freezing point and much lower volatility), with reportedly similar characteristics to HD. T is not expected to constitute an airborne vapor hazard.

<b>ADDITIONAL INFORMATION</b>	<p><b>Trade Names and Other Synonyms:</b></p> <ul style="list-style-type: none"> <li>● yperite; Y</li> <li>● Kampfstoff Lost</li> <li>● Sulphur mustard gas</li> <li>● Sulfide, bis (2-chloroethyl)</li> <li>● Bis(beta-chloroethyl)sulfide</li> <li>● 1,1'-thiobis(2-chloroethane)</li> <li>● 1-chloro-2(beta-chloroethylthio)ethane</li> <li>● Beta, beta'-dichlorodiethyl sulfide</li> <li>● 2,2'dichlorodiethyl sulfide</li> <li>● Di-2-chloroethyl sulfide Beta, beta'-dichloroethyl sulfide</li> <li>● Iprit S-Lost</li> <li>● S-yperite</li> <li>● Schwefel-lost</li> <li>● Senfgas</li> <li>● Yellow Cross Liquid</li> <li>● EA 1033</li> </ul>
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<b>GLOSSARY OF ACRONYMS</b>	<p><b>APR</b> - Air-purifying Respirator  <b>CBRN</b> - Chemical, Biological, Radiological, Nuclear  <b>IDLH</b> - Immediately Dangerous to Life and Health  <b>REL</b> - Recommended Exposure Limit  <b>PEL</b> - Permissible Exposure Limit  <b>SCBA</b> - Self-Contained Breathing Apparatus</p>
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<b>IMPORTANT NOTICE:</b>	<p><b>MUSTARD (ERC: 505-60-2)</b> The user should verify compliance of the cards with the relevant STATE or TERRITORY legislation before use. NIOSH, CDC 2003.</p>
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